

immunoprecipitation, etc.), immobilization (e.g on a solid substrate), etc., followed by washing by, for example, membrane filtration (e.g. Whatman's P-18 ion exchange paper, Polyfiltronic's hydrophobic GFC membrane, etc.), gel chromatography (e.g. gel filtration, affinity, etc.). For Toll-dependent transcription assays, binding is detected by a change in the expression of a Toll-dependent reporter.

Detection may be effected in any convenient way. For cell-free binding assays, one of the components usually comprises or is coupled to a label. The label may provide for direct detection as radioactivity, luminescence, optical or electron density, etc., or indirect detection, such as, an epitope tag, an enzyme, etc. A variety of methods may be used to detect the label depending on the nature of the label and other assay components, e.g. through optical or electron density, radiative emissions, nonradiative energy transfers, etc. or indirectly detected with antibody conjugates, etc.

Nucleic acid encoding the Toll polypeptides disclosed herein may also be used in gene therapy. In gene therapy applications, genes are introduced into cells in order to achieve *in vivo* synthesis of a therapeutically effective genetic product, for example for replacement of a defective gene. "Gene therapy" includes both conventional gene therapy where a lasting effect is achieved by a single treatment, and the administration of gene therapeutic agents, which involves the one time or repeated administration of a therapeutically effective DNA or mRNA. Antisense RNAs and DNAs can be used as therapeutic agents for blocking the expression of certain genes *in vivo*. It has already been shown that short antisense oligonucleotides can be imported into cells where they act as inhibitors, despite their low intracellular concentrations caused by their restricted uptake by the cell membrane. (Zamecnik *et al.*, Proc. Natl. Acad. Sci. USA **83**, 4143-4146 [1986]). The oligonucleotides can be modified to enhance their uptake, e.g. by substituting their negatively charged phosphodiester groups by uncharged groups.

There are a variety of techniques available for introducing nucleic acids into viable cells. The techniques vary depending upon whether the nucleic acid is transferred into cultured cells *in vitro*, or *in vivo* in the cells of the intended host. Techniques suitable for the transfer of nucleic acid into mammalian cells *in vitro* include the use of liposomes, electroporation, microinjection, cell fusion, DEAE-dextran, the calcium phosphate precipitation method, etc. The currently preferred *in vivo* gene transfer techniques include transfection with viral (typically retroviral) vectors and viral coat protein-liposome mediated transfection (Dzau *et al.*, Trends in Biotechnology **11**, 205-210 [1993]). In some situations it is desirable to provide the nucleic acid source with an agent that targets the target cells, such as an antibody specific for a cell surface membrane protein or the target cell, a ligand for a receptor on the target cell, etc. Where liposomes are employed, proteins which bind to a cell surface membrane protein associated with endocytosis may be used for targeting and/or to facilitate uptake, e.g. capsid proteins or fragments thereof tropic for a particular cell type, antibodies for proteins which undergo internalization in cycling, proteins that target intracellular localization and enhance intracellular half-life. The technique of receptor-mediated endocytosis is described, for example, by Wu *et al.*, J. Biol. Chem. **262**, 4429-4432 (1987); and Wagner *et al.*, Proc. Natl. Acad. Sci. USA **87**, 3410-3414 (1990). For review of the currently known gene marking and gene therapy protocols see Anderson *et al.*, Science **256**, 808-813 (1992).

The various uses listed in connection with the Toll proteins herein, are also available for agonists of the native Toll receptors, which mimic at least one biological function of a native Toll receptor.

Neurotrimin as well as other members of the IgLON subfamily of the immunoglobulin superfamily have

been identified to have effect upon neural patterning, differentiation, maturation and growth. As a result, PRO337 the human neurotrimin homolog polypeptides would be expected to have utility in diseases which are characterized by neural disfunction. For example, motoneuron disorders such as amyotrophic lateral sclerosis (Lou Gehrig's disease), Bell's palsy, and various conditions involving spinal muscular atrophy, or paralysis. NGF variant formulations of the invention can be used to treat human neurodegenerative disorders, such as Alzheimer's disease, Parkinson's disease, epilepsy, multiple sclerosis, Huntington's chorea, Down's Syndrome, nerve deafness, and Meniere's disease. Moreover PRO337 polypeptide may also be used as a cognitive enhancer, to enhance learning particularly in dementia or trauma, such as those associated with the above diseases.

Further, PRO337 may be employed to treat neuropathy, and especially peripheral neuropathy. "Peripheral neuropathy" refers to a disorder affecting the peripheral nervous system, most often manifested as one or a combination of motor, sensory, sensorimotor, or autonomic neural dysfunction. The wide variety of morphologies exhibited by peripheral neuropathies can each be attributed uniquely to an equally wide number of causes. For example, peripheral neuropathies can be genetically acquired, can result from a systemic disease, or can be induced by a toxic agent. Examples include but are not limited to diabetic peripheral neuropathy, distal sensorimotor neuropathy, or autonomic neuropathies such as reduced motility of the gastrointestinal tract or atony of the urinary bladder. Examples of neuropathies associated with systemic disease include post-polio syndrome or AIDS-associated neuropathy; examples of hereditary neuropathies include Charcot-Marie-Tooth disease, Refsum's disease, Abetalipoproteinemia, Tangier disease, Krabbe's disease, Metachromatic leukodystrophy, Fabry's disease, and Dejerine-Sottas syndrome; and examples of neuropathies caused by a toxic agent include those caused by treatment with a chemotherapeutic agent such as vincristine, cisplatin, methotrexate, or 3'-azido-3'-deoxythymidine. Correspondingly, neurotrimin antagonists would be expected to have utility in diseases characterized by excessive neuronal activity.

Endothelin is generated from inactive intermediates, the big endothelins, by a unique processing event catalyzed by the zinc metalloprotease, endothelin converting enzyme (ECE). ECE was recently cloned, and its structure was shown to be a single pass transmembrane protein with a short intracellular N-terminal and a long extracellular C-terminal that contains the catalytic domain and numerous N-glycosylation sites. ECEs cleave the endothelin propeptide between Trp73 and Val74 producing the active peptide, ET, which appears to function as a local rather than a circulating hormone (Rubanyi, G.M. & Polokoff, M.A., *Pharmacological Reviews* 46: 325-415 (1994). Thus ECE activity is a potential site of regulation of endothelin production and a possible target for therapeutic intervention in the endothelin system. By blocking ECE activity, it is possible stop the production of ET-1 by inhibiting the conversion of the relatively inactive precursor, big ET-1, to the physiologically active form.

ECE-2 is 64% identical to bovine ECE-2 at the amino acid level. ECE-2 is closely related to ECE-1 (63% identical, 80% conserved), neutral endopeptidase 24.11 and the Kell blood group protein. Bovine ECE-2 is a type II membrane-bound metalloproteinase localized in the trans-Golgi network where it acts as an intracellular enzyme converting endogenous big endothelin-1 into active endothelin (Emoto, N. and Yanangisawa, M., *J. Biol. Chem.* 270: 15262-15268 (1995). The bovine ECE-2 mRNA expression is highest in parts of the brain, cerebral cortex, cerebellum and adrenal medulla. It is expressed at lower levels in

mymetrium, testes, ovary, and endothelial cells. Bovine ECE-2 and ECE-1 both are more active on ET-1 as a substrate compared to ET-2 or ET-3, Emoto and Yanangisawa, supra.

Human ECE-2 is 736 amino acids in length with a 31 residue amino-terminal tail, a 23 residue transmembrane helix and a 682 carboxy-terminal domain. It is 94% identical to bovine ECE-2 and 64% identical to human ECE-1. The predicted transmembrane domain is highly conserved between the human and bovine ECE-2 proteins and between human ECE-1 and human ECE-2, as are the putative N-linked glycosylation sites, Cys residues conserved in the neutral endopeptidase 24.11 and the Kell blood group protein family and the putative zinc binding motif. The sequence suggests, that like other members of the NEP-ECE-Kell family, human ECE-2 encodes a type II transmembrane zinc-binding metalloproteinase, which, by extrapolation from what is known about bovine ECE-2, is an intracellular enzyme located within the secretory pathway which processes endogenously produced big ET-1 while it is still in the secretory vesicles. Emoto and Yanangisawa, supra.

The expression pattern of ECE-2 differs from that observed for ECE-1. Northern blot analysis of mRNA levels indicated low levels of expression of a 3.3 kb transcript in adult brain (highest in the cerebellum, putamen, medulla and temporal lobe, and lower in the cerebral cortex, occipital lobe and frontal lobe), spinal cord, lung and pancreas and higher levels of a 4.5 kb transcript in fetal brain and kidney. The two transcript sizes probably represent the use of alternative polyadenylation sites as has been observed for bovine ECE-2 (Emoto and Yanangisawa, supra) and ECE-1 (Xu et al., Cell 78: 473-485 (1994)). PCR on cDNA libraries indicated low levels of expression in fetal brain, fetal kidney, fetal small intestine and adult testis. Fetal liver, fetal lung and adult pancreas were all negative.

The endothelin (ET) family of peptides have potent vascular, cardiac and renal actions which may be of pathophysiological importance in many human disease states. ET-1 is expressed as an inactive 212 amino acid prepropeptide. The prepropeptide is first cleaved at Arg52-Cys53 and Arg92-Ala93 and then the carboxy terminal Lys91 and Arg92 are trimmed from the protein to generate the propeptide big ET-1. ECEs then cleave the propeptide between Trp73 and Val74, producing the active peptide, ET, which appears to function as a local rather than a circulating hormone (Rubanyi and Polokoff, Pharma. R. 46: 325-415 (1994)).

Endothelins may play roles in the pathophysiology of a number of disease states including: 1) cardiovascular diseases (vasospasm, hypertension, myocardial ischemia; reperfusion injury and acute myocardial infarction, stroke (cerebral ischemia), congestive heart failure, shock, atherosclerosis, vascular thickening); 2) kidney disease (acute and chronic renal failure, glomerulonephritis, cirrhosis); 3) lung disease (bronchial asthma, pulmonary hypertension); 4) gastrointestinal disorders (gastric ulcer, inflammatory bowel diseases); 5) reproductive disorders (premature labor, dysmenorrhea, preeclampsia) and 6) carcinogenesis. Rubanyi & Polokoff, supra.

Diseases can be evaluated for the impact of ET upon them by examining: 1) increased production of ETs; 2) increased reactivity to ETs; and/or 3) efficacy of an ET receptor antagonist, antibody or ECE inhibitor. Response to the previous criteria suggest that ETs likely play roles in cerebral vasospasm following subarachnoid hemorrhage, hypertension (fulminant/complications), acute renal failure and congestive heart failure. While inhibitors of ET production or activity have not been used in models of coronary vasospasm, acute myocardial infarction, and atherosclerosis, they do have elevated ET levels and increase reactivity to ETs. Shock and pulmonary hypertension also exhibit elevated ET levels (Rubanyi and Polokoff, supra). Inhibition of ECEs in